RUST GEOTECH INC.

Spectral Gamma-Ray Borehole
Log Data Report

Borehole 51-03-12

Log Event A

Borehole Information

Farm : TX	**Tank :** TX-103	**Site Number :** 299-W15-126
N-Coord : 41,698	**W-Coord :** 75,954	**TOC Elevation :** 671.03
Water Level, ft :	**Date Drilled :** 11/30/1971	

Casing Record

Type : Steel-welded	Thickness : 0.280	ID, in. : 6
Top Depth, ft. : 0	Bottom Depth, ft. : 100	

Borehole Notes:
This borehole was completed to a depth of 100 ft in November 1971. The borehole was driven with 6-in. casing for its entire length. There is no indication that the borehole was started with a larger casing, and there is no indication that the bottom of the borehole was cemented or that the space between the borehole wall and the permanent 6-in. casing was grouted.

The top of the casing is the starting depth for the logs. The casing collar is about even with the ground surface. The casing thickness is presumed to be 0.280 in., on the basis of published thickness for schedule-40, 6-in. steel tubing.

Equipment Information

Logging System : 2	**Detector Type :** HPGe	**Detector Efficiency:** 35.0 %
Calibration Date : 10/1995	**Calibration Reference :** GJPO-HAN-3	**Logging Procedure :** P-GJPO-1783

Log Run Information

Log Run Number : 1	**Log Run Date :** 12/22/1995	**Logging Engineer:** Alan Pearson
Start Depth, ft.: 100.0	**Counting Time, sec.:** 100	**L/R :** L **Shield :** N
Finish Depth, ft. : 57.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a

Log Run Number : 2	**Log Run Date :** 12/27/1995	**Logging Engineer:** Alan Pearson
Start Depth, ft.: 100.0	**Counting Time, sec.:** 100	**L/R :** L **Shield :** N
Finish Depth, ft. : 34.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a

Log Run Number : 3	**Log Run Date :** 12/28/1995	**Logging Engineer:** Alan Pearson
Start Depth, ft.: 0.0	**Counting Time, sec.:** 100	**L/R :** L **Shield :** N
Finish Depth, ft. : 35.0	**MSA Interval, ft. :** 0.5	**Log Speed, ft/min.:** n/a

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Analysis Information

Analyst : H.D. Mac Lean

Data Processing Reference : P-GJPO-1787 Analysis Date : 9/17/1996

Analysis Notes :

This borehole was logged in three log runs. Depths from the first log run were repeated because of the possibility of an error in the information supplied by the depth encoder. The zero-reference check procedure failed to confirm the indicated depth of a reference point common to the start and end of the logging run. A vigorous investigation of this error (described in Nonconformance Report N-96-42) did not identify an exact cause and no similar depth errors were found during a review of repeated logging run segments from other boreholes. Nevertheless, depths recorded by the encoder are being carefully monitored to assure that this occurrence was not related to a mechanical failure of the depth encoder.

The pre- and post-survey field verification spectra met the acceptance criteria established for the peak-shape and system efficiency, confirming the SGLS system was operating within specifications. The energy calibration and peak-shape calibration from these verification spectra were used to establish the channel-to-energy parameters used to process the spectra acquired during the logging operation.

Casing correction factors for a 0.280-in.-thick steel casing were applied during analysis.

Overlaps, where the same interval of the borehole was logged by separate runs, occurred between depths of 34 and 35 ft. In addition, the radionuclide concentrations calculated using the separate data sets provided by the first log run (between depths of 80 and 56 ft, where the depths were known to be accurate) and the repeat log run (log run 2) were compared. Calculated concentrations of the man-made radionuclides (Cs-137 and Co-60) and the naturally occurring radionuclides (K-40 and Th-232) using the separate data sets at these overlapping acquisition points were within the statistical uncertainty of the measurements, indicating very good repeatability of the data. The measured concentration of U-238 using the separate data sets exceeded the statistical uncertainty of the calculations; however, the determination of the concentration of this nuclide assumes equilibrium with Bi-214, which is affected by radon. The amount of radon in the borehole is not stable between logging runs.

The man-made radionuclides Cs-137, Co-60, Eu-154, and Eu-152 were identified in this borehole. The Cs-137 was detected in the upper 20 ft of the borehole. The other radionuclide contaminants were detected in the interval between depths of 51 and 69 ft.

The Cs-137 occurs mainly within the upper 21 ft of the borehole. Calculated concentrations are less than 10 pCi/g and generally less than about 3 pCi/g. The maximum Cs-137 concentration in this interval (about 10 pCi/g) occurs at a depth of about 1 ft below the surface. Other occurrences of Cs-137 were detected intermittently throughout the length of the borehole.

The Co-60, Eu-154, and Eu-152 contaminants were encountered below a lithologic contact that occurs at a depth of about 52 ft below the surface. The lithologic unit below this contact appears to form a preferential flow path. The Eu-154 and the Eu-152 contaminants occur in a zone that extends between depths of about 51 to 59.5 ft. Calculated Eu-154 concentrations in this zone range as high as about 75 pCi/g at a depth of 53.5 ft.

The Co-60 contamination that occurs in the depth interval between 51 and 68 ft is substantial. Measured

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concentrations range from about 2 pCi/g to about 74.5 pCi/g. Contamination continues between the base of this zone and a depth of 75 ft (in concentrations that are generally less than 1 pCi/g). A second zone of minor Co-60 contamination (concentrations below 1 pCi/g) extends from a depth of 91 ft to the bottom of the borehole.

A zone of anomalous radiometric activity between the depths of 54 and 60 ft is evident in the earliest gross gamma-ray log for which actual log data is available. The activity of the zone has decreased in the intervening years at a rate that is consistent with the radioactive decay of Co-60 and Eu-154. The anomalous zone identified in 1981 has subsequently expanded downward to its present location between the depths of 51 and 67 ft.

The presence of Co-60 is indicated by both the 1173-keV and 1332-keV spectral peaks. The presence of Eu-154 is indicated by the spectral peak at 1274 keV, and confirmed by spectral peaks at 1004, 873, 756, 723, 248, and 123 keV. The presence of Eu-152 is indicated by spectral peaks that correspond to gamma rays with energies of 121 and 1408 keV. Calculated radionuclide concentrations using the various spectral energies are generally within the statistical uncertainty of the calculations, substantiating the concentration algorithms and calculation procedures.

Additional information and interpretations of log data are included in the main body of the TSDR for tank TX-103.

Log Plot Notes:

Separate log plots show the man-made radionuclides (Cs-137, Co-60, and Eu-154) and the naturally occurring radionuclides (KUT). The natural radionuclides can be used for lithology interpretations. The headings of the plots identify the specific gamma rays used to calculate the concentrations.

A combination plot includes both the man-made and natural radionuclides, in addition to the total gamma derived from the spectral data and the Tank Farm gross gamma log. The gross gamma plot displays the latest available digital data. No attempt has been made to adjust the depths of the gross gamma logs to coincide with the SGLS data.

Uncertainty bars on the plots show the statistical uncertainties for the measurements as 95-percent confidence intervals. Open circles on the plots give the MDL. The MDL of a radionuclide represents the lowest concentration at which positive identification of a gamma-ray peak is statistically defensible.

A compilation of representative historical gross gamma-ray logs at three-year intervals starting from December 1981, and the the SGLS total count-rate log acquired early in 1996, indicates a zone of anomalous radiometric activity in the depth interval between approximately 51 and 68 ft.

A separate plot is included that compares the measured concentrations of Cs-137, Co-60, and the naturally occurring radionuclides in the repeated log interval. The radionuclide concentrations shown were calculated using the separate data sets provided by the original and repeated logging runs of a portion of the borehole.